

Field Evaluation of UNI-TEC SENS-IT Sensor



Background

- From 7/1/2015 to 7/31/2015, nine **SENS-IT** gaseous sensors were deployed in Rubidoux and were run side-by-side SCAQMD Federal Reference Method (FRM) instruments measuring the same pollutants
- SENS-IT (9 units tested):
 - Gaseous sensors (**metal oxide; non-FRM**)
 - Single pollutant measurements [i.e. 3 units for CO (ppm); 3 units for NO₂ (ppb); 3 units for Ozone (ppb)]
 - **Unit cost: ~\$2,200**
 - Time resolution: 1-min
 - Units IDs:
 - NO₂ sensors: U194, U144, U068
 - Ozone sensors: U190, U057, U059
 - CO sensors: U197, U247, U245
- SCAQMD FRM instruments:
 - CO instrument; **cost: ~\$10,000**
 - Time resolution: 1-min
 - NO_x instrument; **cost: ~\$11,000**
 - Time resolution: 1-min
 - O₃ instrument; **cost: ~\$7,000**
 - Time resolution: 1-min

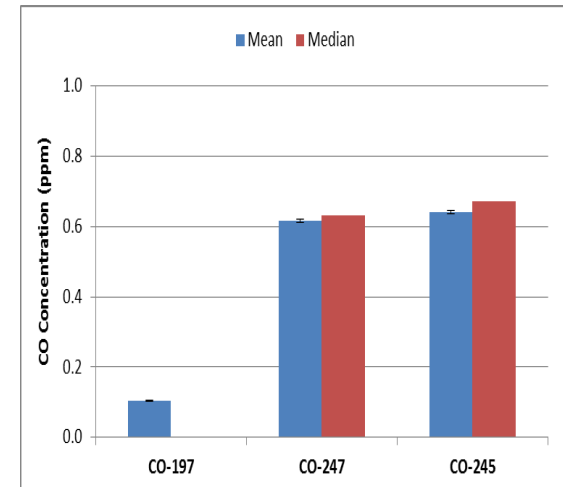
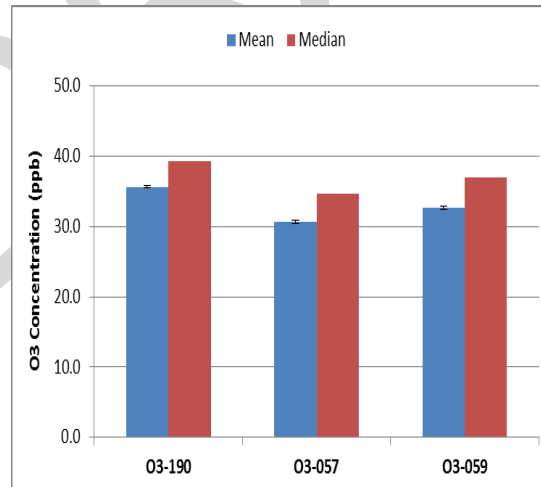
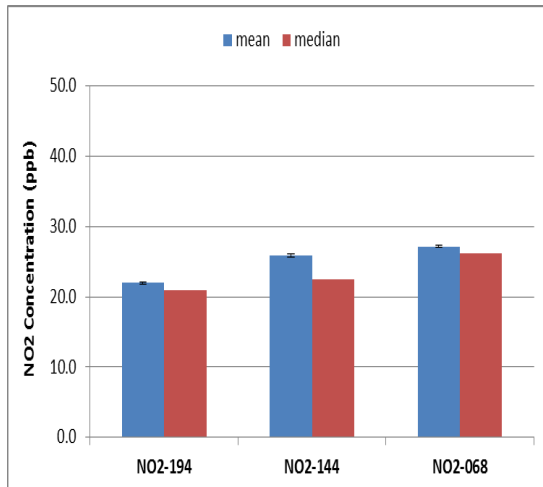


Data validation & recovery

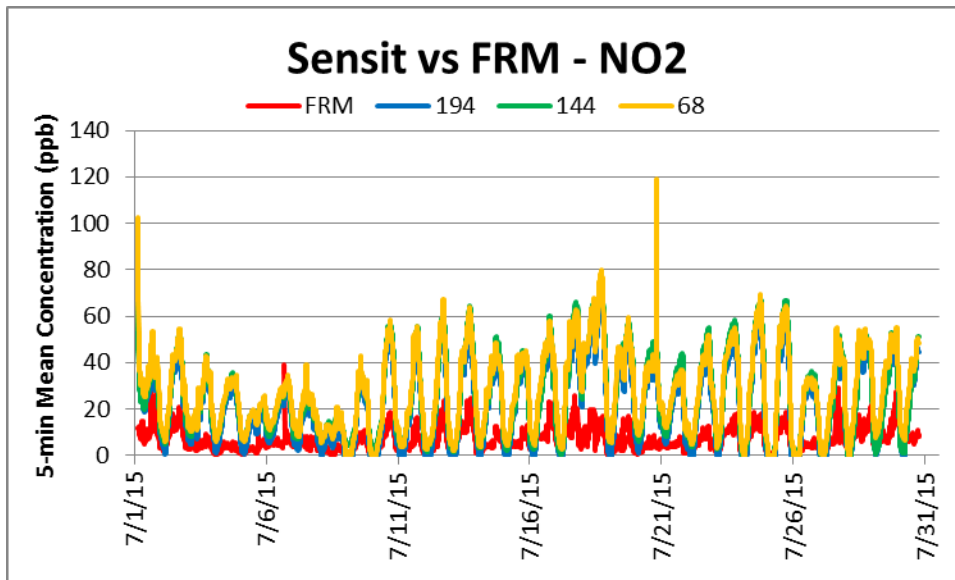
- Basic QA/QC procedures were used to validate the collected data (i.e. obvious outliers, negative values, and invalid data-points were eliminated from the data-set)
- For all units/pollutants tested data recovery was very high (i.e. >99%)

SENS-IT; intra-model variability

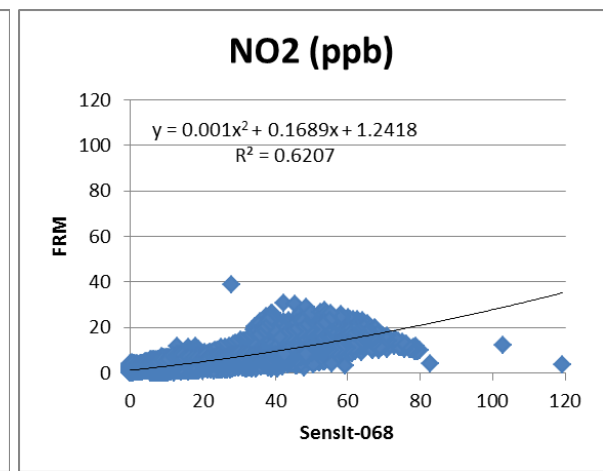
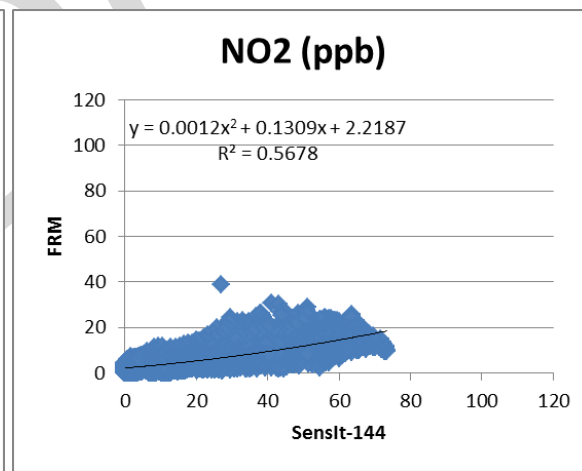
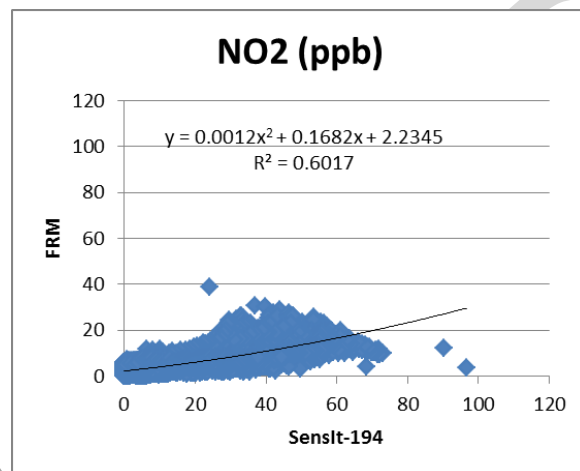
- Relatively low intra-model variability was observed for all SENS-IT sensors. However, unit U197 (measuring CO) provided invalid data.



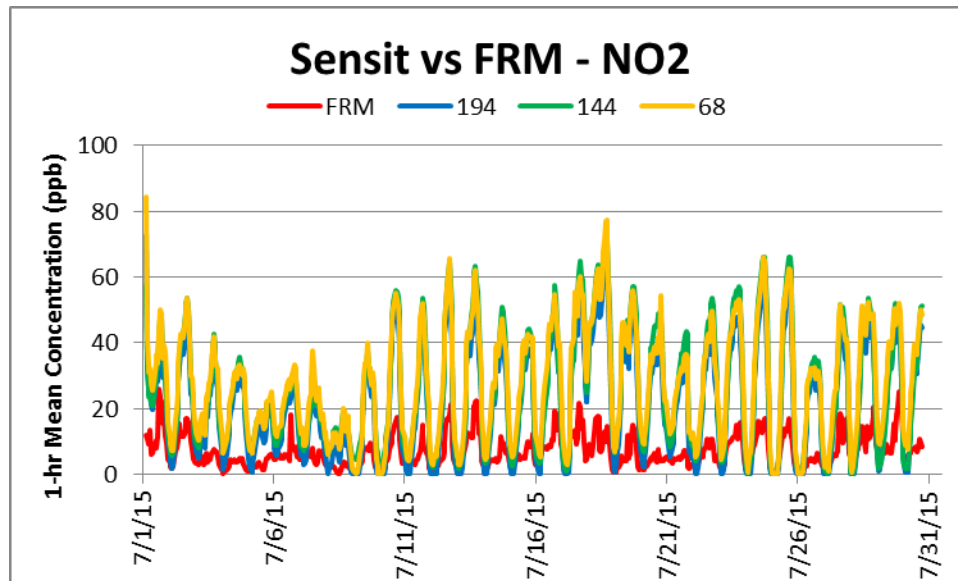
SENS-IT vs FRM (NO₂; 5-min mean)



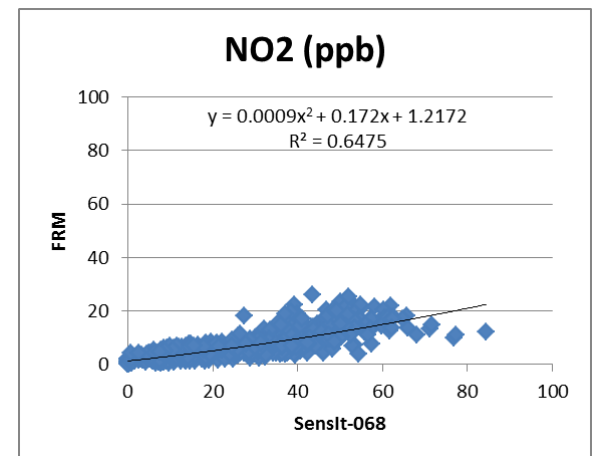
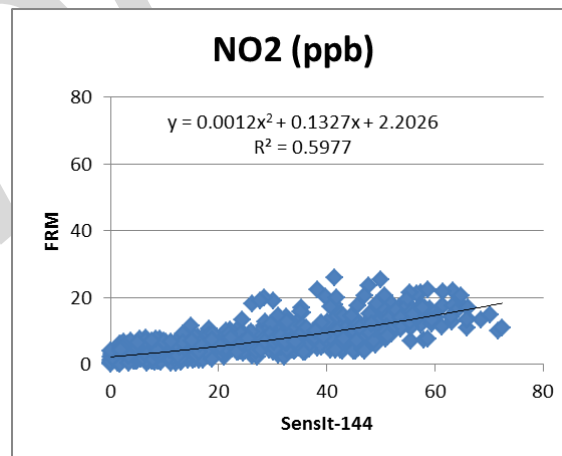
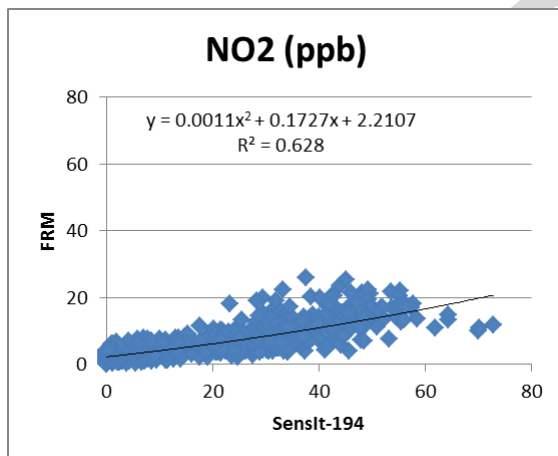
- Overall, all NO₂ measurements correlate fairly well with the corresponding FRM data ($0.57 < R^2 < 0.62$), but the three SENS-IT sensors largely overestimated measured NO₂ concentrations



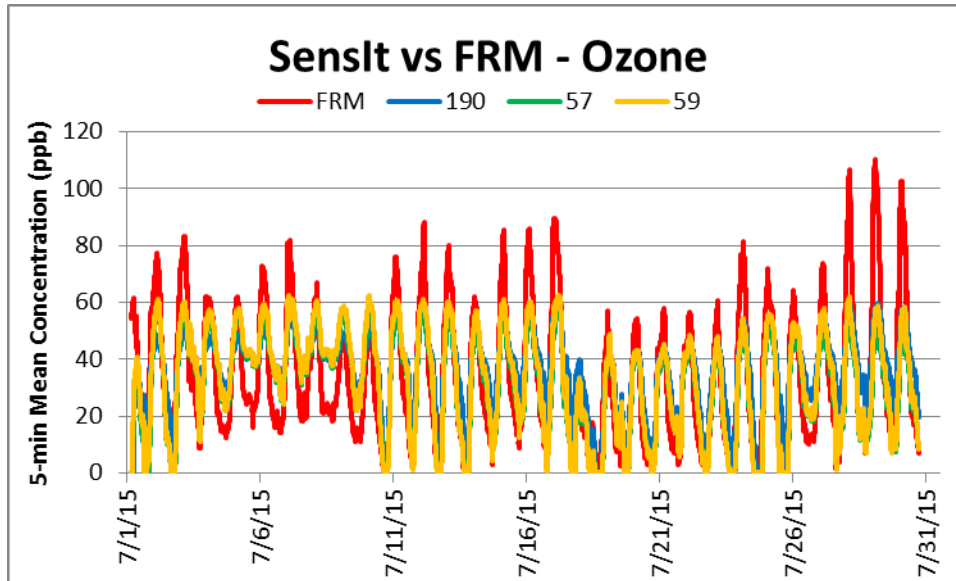
SENS-IT vs FRM (NO₂; 1-hr mean)



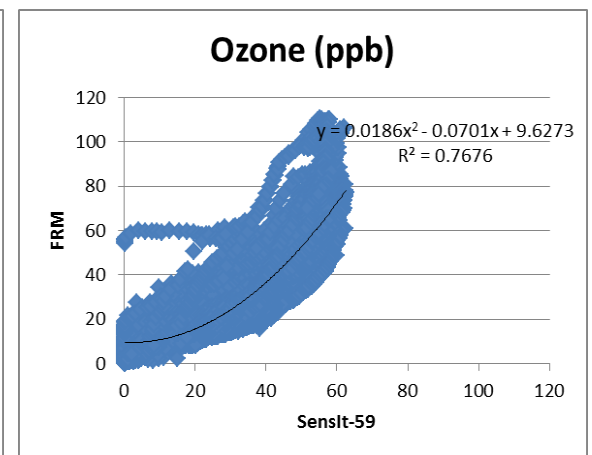
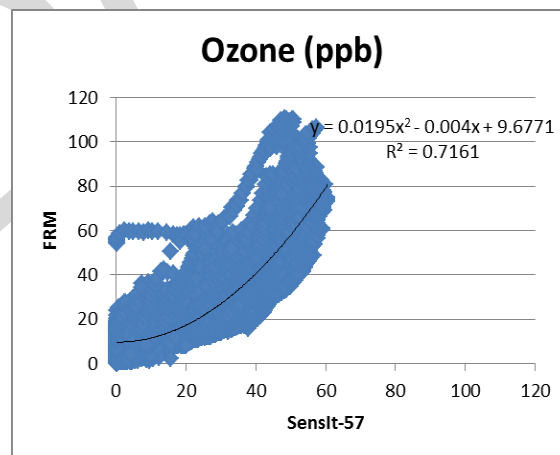
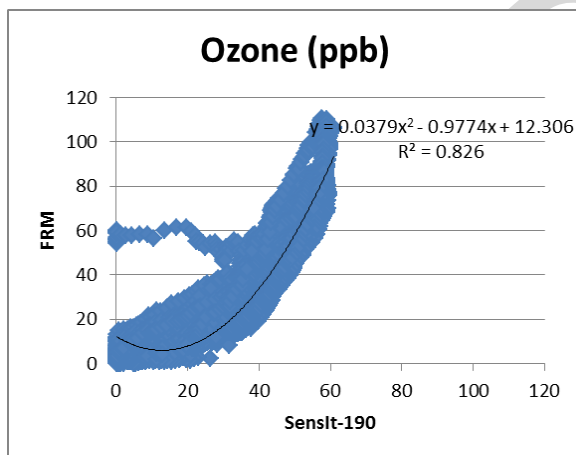
- NO₂ measurements correlate fairly well with the corresponding FRM data ($0.60 < R^2 < 0.65$), but the three SENS-IT sensors largely overestimated measured NO₂ concentrations



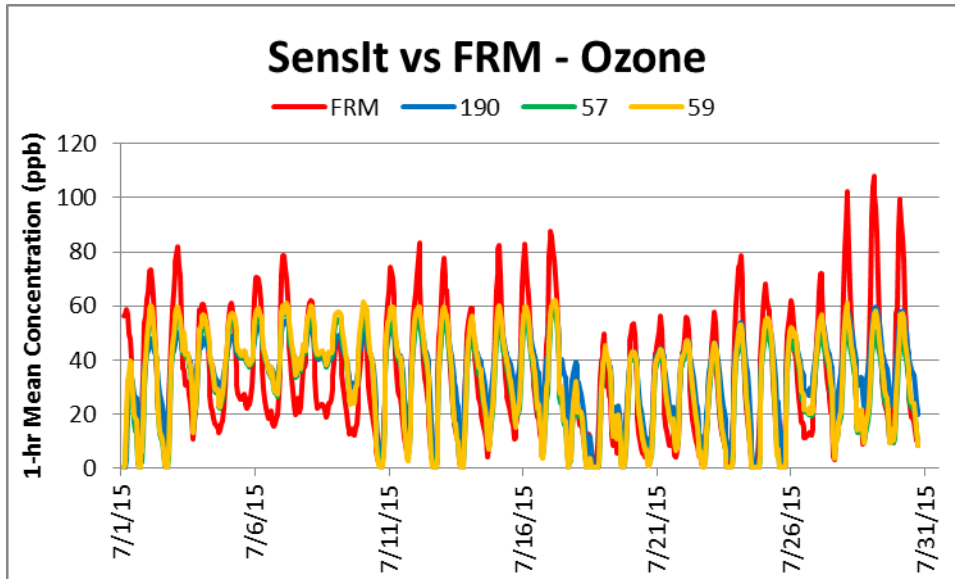
SENS-IT vs FRM (Ozone; 5-min mean)



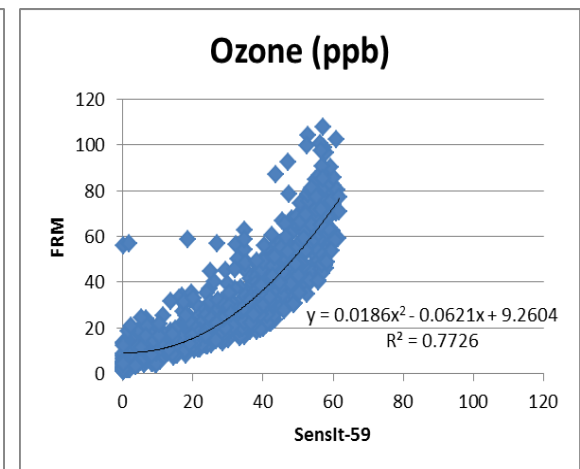
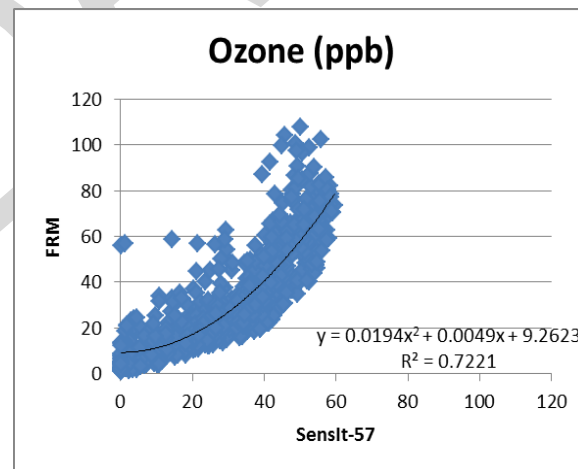
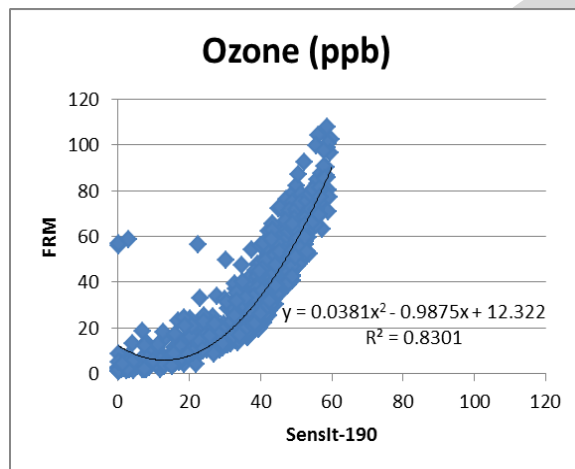
- Ozone measurements correlate very well with the corresponding FRM data ($0.72 < R^2 < 0.83$), but the three SENS-IT sensors underestimated measured Ozone concentrations



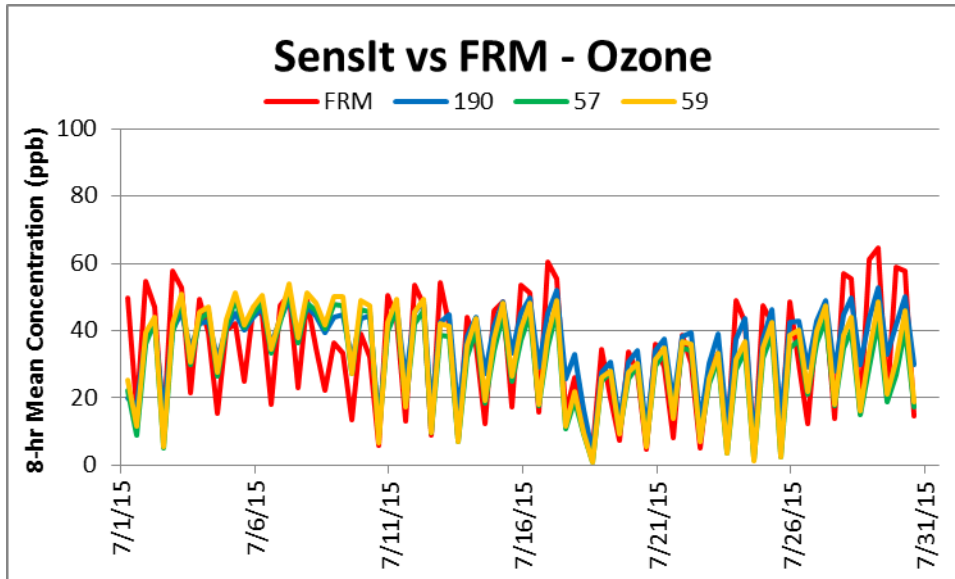
SENS-IT vs FRM (Ozone; 1-hr mean)



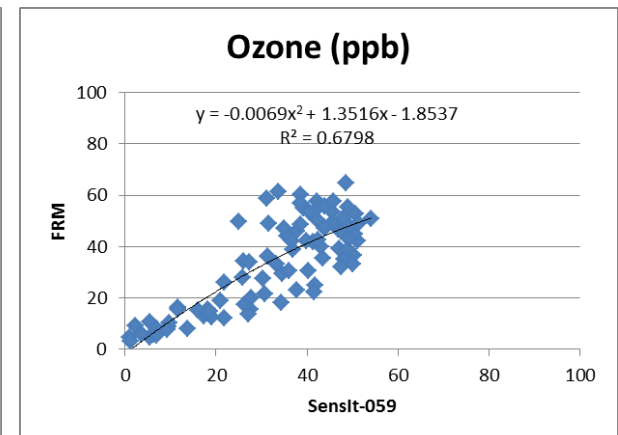
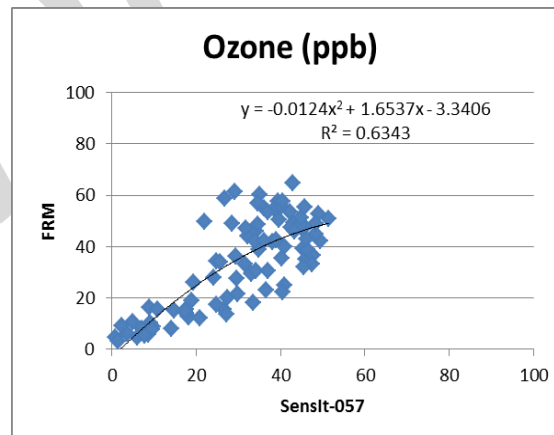
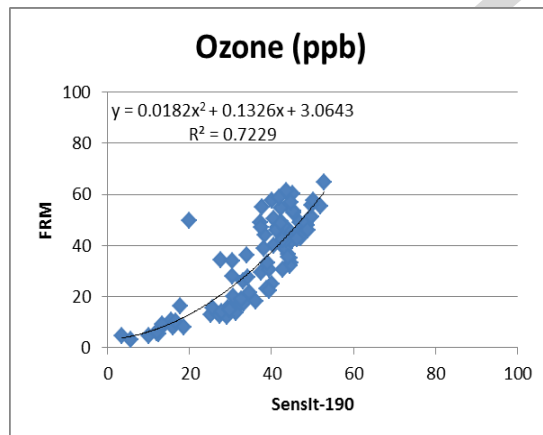
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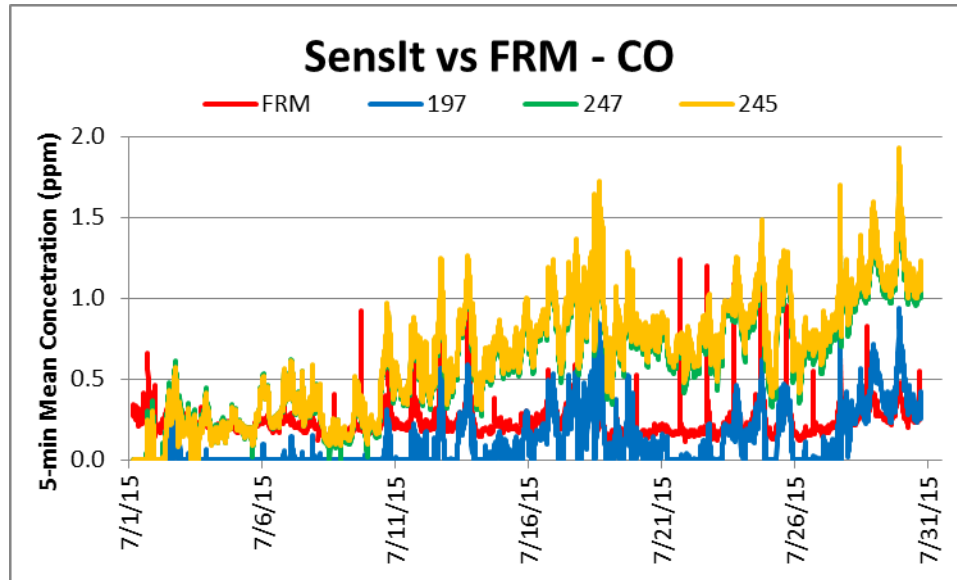
SENS-IT vs FRM (Ozone; 8-hr mean)



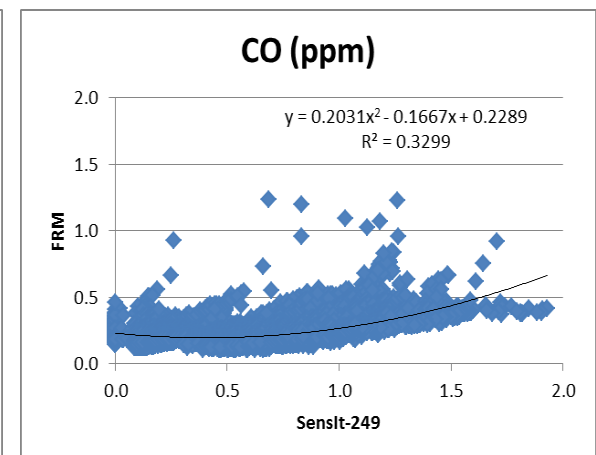
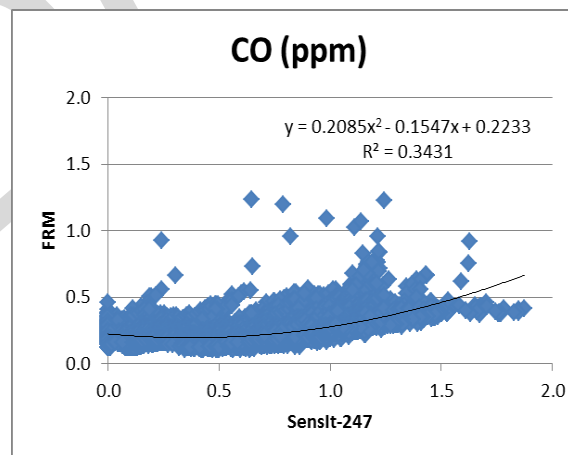
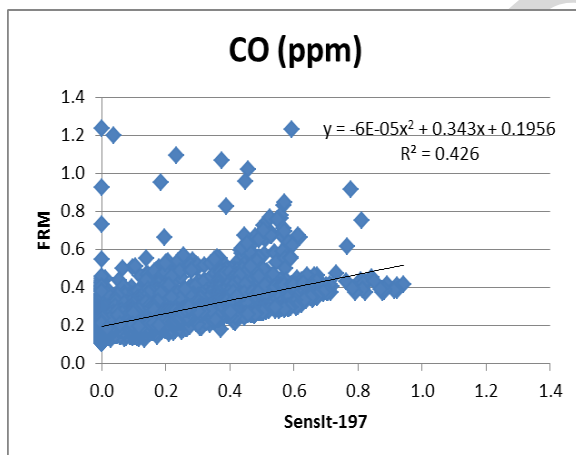
- Ozone measurements correlate well with the corresponding FRM data ($0.63 < R^2 < 0.72$)



SENS-IT vs FRM (CO; 5-min mean)



- Poor correlation between CO measurements and the corresponding FRM data ($0.33 < R^2 < 0.43$)



Discussion

- Data recovery from the tested SENS-IT Sensors was very high (i.e. no down time over a period of one month)
- Overall, all SENS-IT devices were characterized by low intra-model variability despite the fact that one CO unit produced invalid data
- Despite the good correlation (R^2) between the NO_2 sensors and the corresponding FRM instrument, the magnitude of the NO_2 sensor measurements was largely overestimated. Conversely, although the Ozone sensors were well correlated with a substantially more expensive FRM instrument, the magnitude of the Ozone sensor measurements was underestimated
- The CO sensors correlate poorly with the corresponding FRM monitor
- It should be noted that no sensor calibration had been performed by SCAQMD Staff prior to the beginning of this field testing
- Laboratory chamber testing under temperature- and relative humidity- controlled conditions, known individual gas concentrations and known concentrations of interferent gas mixtures is necessary to fully evaluate the performance of these Unitec SENS-IT sensors
- All results are still preliminary